

REMARKS/ARGUMENTS

Introduction

In the present amendment, independent claim 1 and dependent claims 9, 16 and 18 are amended, and new dependent claims 21-25 are added. Claims 1-25 are presently
5 pending in this application with claims 19 and 20 withdrawn from consideration. Applicants respectfully request reconsideration of the application in view of the foregoing amendments and the following remarks/arguments.

Amendments to the Claims

Claim 1, line 2, has been amended to recite that the hardness-promoting microalloy
10 is comprised of vanadium and nitrogen. Support for this amendment can be found throughout the application as originally filed, for example in original claim 9.

Claim 1 has been further amended at paragraph (g) for consistency with paragraph [00027] of the application as originally filed, in order to recite that the temperature of the hot rolled product exiting the second rolling apparatus is greater than a temperature at
15 which austenite is transformed to ferrite and is greater than a temperature at which significant precipitation of the microalloy will occur in the second rolling apparatus.

Claim 9 has been amended as a consequence of the amendment to claim 1, by deleting the recital that the microalloy is comprised of vanadium and nitrogen.

Claim 16, line 1, has been amended by replacing “step (d)” by --step (f)--, and claim 18 has been amended by replacing “step (c)” by --step (e)--.

New dependent claims 21 to 25 have been placed on file to define preferred temperature parameters for a number of the process steps. Claim 21 defines a preferred temperature during step (b) and is supported in the application as originally filed at paragraph [00019]. Claim 22 defines a preferred temperature at which the as-cast steel product enters the first rolling apparatus and is supported in the application as originally filed at paragraph [00021]. Claim 23 defines a preferred temperature at which the rough-reduced product enters the second rolling apparatus and is supported in the application as originally filed at paragraph [00027]. Claims 24 and 25 define preferred temperatures at which the hot rolled product exits the second rolling apparatus and are supported in the application as originally filed at paragraphs [00027] and [0007], respectively.

Applicants submit that these amendments do not add any new matter.

15 Claim Objections

Claims 16 and 18 have been amended by correcting the typographical errors noted by the Examiner, thereby traversing the objections.

Claim Rejections – 35 USC 103

Claims 1-18 stand rejected under 35 USC 103(a) as being unpatentable over Cornelissen et al. (U.S. Patent 6,280,542) alone or in view of the Crowther et al. publication.

A – Patentability of Claims Over Cornelissen et al. Alone

5 Cornelissen et al. discloses a method and apparatus for the manufacture of a steel strip.

According to the method disclosed by Cornelissen et al., “molten steel is cast in a continuous casting machine into a slab and, while making use of the casting heat, is conveyed through a furnace apparatus, is roughed in a roughing apparatus, and finish-
10 rolled in a finishing apparatus into a steel strip of a desired finished thickness” (column 1, lines 5-10).

According to column 2, lines 19-20 of Cornelissen et al., the invention disclosed therein is based on a plurality of new and inventive notions. One new notion is that the method and apparatus of Cornelissen et al. can be used to prepare an austenitically rolled
15 steel strip and a ferritically rolled steel strip with properties of a cold-rolled steel strip (column 2, lines 19-25). According to Cornelissen et al., “this opens up the possibility of manufacturing a wider range of steel strips in an apparatus of itself known more particularly of manufacturing with it steel strips which have a considerably higher added value on the market”.

A second new notion disclosed by Cornelissen et al. is that the method disclosed therein can be employed in a “semi-endless or endless process” (column 2, lines 35-38).

The specific method steps for the manufacture of ferritically rolled steel strip and austenitically rolled steel strip are described by Cornelissen at column 1, line 62 to
 5 column 2, line 10. The method for producing ferritically rolled steel strip is referred to as “step a” and the method for manufacturing austenitically rolled steel strip is referred to as “step b”. According to step b, “the strip leaving the roughing apparatus is heated to or held at a temperature in the austenitic range and is rolled in the finishing apparatus essentially in the austenitic range to the finished thickness and, following that rolling, is
 10 cooled down to a temperature in the ferritic range”.

As discussed below, Applicants disagree in a number of respects with the Examiner’s characterization of the teachings of Cornelissen et al.

For example, at paragraph 14 of the Office Action, the Examiner states that “prior art on lines 17 to 23 in column 6 discloses using a high strength steel and TRIP-steels,
 15 which would include micro-alloy steel containing V and N as recited by claim 9”. Applicants respectfully disagree. There is no teaching or suggestion anywhere in the Cornelissen et al. reference that the method and apparatus disclosed therein are applicable to high strength, low alloy steel containing a hardness-promoting microalloy, nor is there any teaching or suggestion that the microalloy is comprised of vanadium and nitrogen, as

recited by amended claim 1.

In addition, the method parameters taught by Cornelissen et al., and in particular the temperature parameters, would not be appropriate to prepare high strength, low alloy steel containing a hardness-promoting microalloy, as in the invention claimed by the Applicants. Furthermore, although Cornelissen et al. mentions formability of steel products according to the prior art (col. 5, lines 43-51), there is no mention of the formability of steel products produced according to the Cornelissen et al. process. The Applicants believe that the process of Cornelissen et al. does not produce steel products having high strength and high formability, as produced by the presently claimed process.

At paragraphs 9 and 11 of the Office Action, the Examiner discusses the temperature ranges applicable to the Cornelissen et al. process. In particular, the Examiner states at paragraph 9 that Cornelissen teaches the following:

“Conducting a rough reduction step in the first rolling apparatus to reduce the thickness of the as-cast steel slab, holding the rough-reduced product in the austenitic temperature range, transferring the rough-reduced product to a second rolling apparatus, conducting a final reduction step in the austenitic temperature range, and cooling down to ferritic temperature range” (emphasis added).

At paragraph 11 of the Office Action, the Examiner states the following:

“Prior art process in claim 18 and lines 60 to 68 in column 4 discloses an austenitic temperature to be in the range of 1050 to 1200C and preferably 1110 to 1200C, and would suggest the 1020 to 1150C recited by claim 18 (the temperature range above the recrystallization stop temperature of the austenite), and within the 1050C recited by claim 9 (the temperature above the precipitation temperature)” (emphasis added).

With regard to paragraph 9 of the Office Action, Cornelissen et al. teaches that “the strip leaving the roughing apparatus is heated to or held at a temperature in the austenitic range” (col. 2, lines 6-7), and that it “is rolled in the finishing apparatus essentially in the austenitic range” (col. 2, lines 7-9). The “austenitic range” defined by Cornelissen et al., however, appears to be in the range of 850-910°C depending on the carbon content (col. 4, lines 40-45), or possibly 850-920°C (col. 4, line 47).

With regard to paragraph 11 of the Office Action, the temperature range of 1050-1200°C is indeed taught by Cornelissen et al., and it can be inferred from Cornelissen et al. that the strip will be in the austenitic state when heated to a temperature within this range. However, the temperature range of 1050-1200°C is only applicable to the early stages of the Cornelissen et al. process. Following the initial rolling step in the roughing apparatus, the temperature of the strip in Cornelissen et al. is reduced to a level which is significantly lower than the range of 1050-1200°C. This is now discussed further with reference to Figures 1 and 2 of Cornelissen et al.

Figure 1 of Cornelissen et al. schematically illustrates an apparatus for producing a steel strip and Figure 2 graphically represents the temperature variation in the strip as it passes through the apparatus. It will be seen from Figure 2 that the initial temperatures of the austenitic (a) and ferritic (f) strips are the same as they move through the tunnel

5 furnace 7. The use of water to remove oxide with the oxide removal apparatus 9 has the effect of cooling the slab from 1150°C to 1050°C before it enters the roughing apparatus 10 (Figure 2 and column 11, lines 48-50). As it passes through the roughing apparatus, the temperature of the slab falls from 1050°C to 950°C (Figure 2 and column 11, lines 53-59). Following the rougher, the temperatures of the austenitic and ferritic processes
10 diverge, with the austenitic strip being maintained or heated to a temperature of 950°C until it reaches the second oxide removal installation and the strip is rolled in the rolling train 14 at approximately 900°C. According to Cornelissen et al. maintaining the strip at a temperature of about 900°C as shown in Figure 2 is a temperature at which the strip is “essentially in the austenitic range”. This is consistent with the teaching at column 4,
15 lines 40-45, referred to above.

Thus, many of the steps of the Cornelissen et al. process are conducted while the temperature of the strip is below the range of 1050-1200°C mentioned by the Examiner as “the temperature range above the recrystallization stop temperature of the austenite” and “the temperature above the precipitation temperature” (para. 11 of Office Action).

20 In contrast, independent claim 1 recites a number of process steps which are

conducted while the steel is at a temperature which is above a recrystallization stop temperature of the austenite and above a precipitation temperature of the microalloy.

This temperature limitation is specifically recited in steps (b), (d), (e) and (g). As recited by claim 9, the precipitation temperature of a microalloy comprised of vanadium and
5 nitrogen is about 1050°C.

In view of the above remarks, it is clear that Cornelissen et al. does not teach or suggest step (d) of claim 1, which recites the following:

“(d) conducting a rough reduction step in the first rolling apparatus to reduce the thickness of the as-cast steel product by a first amount, thereby producing a rough-
10 reduced steel product, wherein a temperature of the as-cast product entering the first rolling apparatus and a temperature of the rough-reduced product exiting the first rolling apparatus are above the recrystallization stop temperature and above the precipitation temperature of the microalloy”.

In contrast to step 1(d), Cornelissen et al. teaches that the temperature of the strip
15 exiting the roughing apparatus is at 950°C (Fig. 2 and col. 11, lines 53-59). There is no teaching or suggestion in Cornelissen et al. that the strip contains a hardness-promoting alloy or that the temperature of 950°C is above the precipitation temperature of the microalloy.

Further, Cornelissen et al. does not teach or suggest step (e) of claim 1, which

recites the following:

“(e) holding the rough-reduced product at a temperature above the recrystallization stop temperature and above the precipitation temperature of the microalloy for a time sufficient to permit substantially complete recrystallization of the austenite and thereby
 5 reduce a grain size of the austenite” (emphasis added).

In contrast to step 1(e), Cornelissen et al. teaches that the strip exiting the roughing apparatus is heated to or maintained at 950°C and that the temperature of the strip is reduced to 900°C before it enters the rolling train 14 (Fig. 2). There is no teaching or suggestion in Cornelissen et al. that the strip contains a hardness-promoting alloy or that
 10 temperatures of 900-950°C are above the precipitation temperature of the microalloy, or that it is held at this temperature for a time sufficient to permit substantially complete recrystallization of the austenite.

Further, Cornelissen et al. does not teach or suggest step (g) of claim 1, which recites the following:

15 “(g) conducting a final reduction step in the second rolling apparatus to reduce the thickness of the rough-reduced product by a second amount, thereby producing a hot rolled steel product, wherein the second amount of thickness reduction is less than the first amount produced in the first rolling apparatus, and wherein a temperature of the rough-reduced product entering the second rolling apparatus is above the precipitation

temperature of the microalloy and above the recrystallization stop temperature, ...”
(emphasis added).

In contrast to step 1(g), Cornelissen et al. teaches that the strip enters the rolling train at a temperature of 900°C or less (Fig. 2). There is no teaching or suggestion in
5 Cornelissen et al. that the strip contains a hardness-promoting alloy or that temperatures of 900°C or lower are above the precipitation temperature of the microalloy.

It is clear from the above discussion that there are significant distinctions between the process according to claim 1 and that disclosed by Cornelissen et al. Applicants believe that the Cornelissen et al. process is not suitable for producing steel products
10 containing a hardness-promoting microalloy, and in particular that the temperature parameters taught by Cornelissen et al. would not be suitable for the production of steel products containing a hardness-promoting microalloy comprised of vanadium and nitrogen. For at least the above reasons, independent claim 1 and dependent claims 2-18 and 21-25 are allowable over Cornelissen et al. alone.

15 **B – Patentability of Claims Over Cornelissen et al. In View Of Crowther**

The Crowther publication was discussed at length in the response filed on January 8, 2007. Crowther discloses a laboratory-scale simulation of a conventional thin slab direct rolling (TSDR) process for producing steels containing hardness-promoting microalloys although, as discussed in the previously-filed response, the Applicants

believe that the product produced by Crowther et al. does not possess high yield strength
and high formability.

Applicants submit that a person of ordinary skill in the art would not be motivated
to combine Cornelissen et al. and Crowther. As mentioned above, Cornelissen et al. does
5 not teach or suggest steel products containing hardness-promoting microalloys and the
process limitations described therein would be unsuitable for production of microalloyed
steels. Accordingly, there would be no motivation to apply the process limitations of
Crowther to the Cornelissen et al. process, and vice versa.

For at least the above reasons, independent claim 1 and dependent claims 2-18 and
10 21-25 are allowable over Cornelissen et al. in view of Crowther.

C – Additional Remarks Regarding Patentability of Dependent Claims

In addition to the reasons discussed above, several of the dependent claims are
patentable over Cornelissen et al. alone and over Cornelissen et al. in view of Crowther.
Additional remarks with regard to these dependent claims are presented below.

15 Claim 12 of the present application recites a preferred formability parameter of the
steels produced by the claimed process. As discussed above, neither Crowther nor
Cornelissen et al. are specifically directed to processes for producing steels having high
formability. Therefore, for this additional reason, claim 12 is allowable over Cornelissen
et al. alone or in combination with Crowther.

Claim 17 recites a preferred time of recrystallization and a preferred degree of recrystallization in the claimed process. Neither Crowther nor Cornelissen et al. teach or suggest the limitations of this claim. Therefore, for this additional reason, claim 17 is allowable over Cornelissen et al. alone or in combination with Crowther.

5 Claim 18 recites a preferred temperature at which the product is held during the recrystallization of step (e), namely from about 1020°C to about 1150°C. Neither Crowther nor Cornelissen et al. teach or suggest a recrystallization step as defined by claim 18 including this temperature limitation. Therefore, for this additional reason, claim 18 is allowable over Cornelissen et al. alone or in combination with Crowther.

10 New claim 23 recites that the temperature of the rough-reduced product entering the second rolling apparatus is substantially the same as the temperature at which the austenite is recrystallized in step (e). Neither Crowther nor Cornelissen et al. teach or suggest a second rolling step including this temperature limitation. Therefore, for this additional reason, claim 23 is allowable over Cornelissen et al. alone or in combination
15 with Crowther.

New claim 25 recites that the hot rolled product exits the second rolling apparatus at a temperature which is above the precipitation temperature of the microalloy. Neither Crowther nor Cornelissen et al. teach or suggest a second rolling step in which the exit temperature of the steel product is at this temperature level. Therefore, for this additional

reason, claim 25 is allowable over Cornelissen et al. alone or in combination with
Crowther.

Respectfully submitted,

WOODLING, KROST & RUST



Kenneth L. Mitchell

Ohio Bar Reg. No. 31587

Florida Bar Reg. No. 382531

Patent Attorney, Reg. No. 36,873

Registered Professional Engineer, Reg. No. 54455

Woodling, Krost and Rust

9213 Chillicothe Road

Kirtland, Ohio 44094

phone nos. 440-256-4150;

fax nos. 440-256-7453;

clevepat@sbcglobal.net